MEETINGBRIEFS>>

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A Primal Crust Found on the Moon, While Mercury's Proves Elusive

Our moon's bright highlands—set against dark "seas" of frozen lava to form the man in the moon—have undergone centuries of ever-closer scrutiny. But it was not until scientists could put moon soil under the microscope that they had any idea where the highlands came from. The highlands, some decided, were the remains of rocky scum that floated to the top of a churning ocean of moon-girdling magma soon after the moon formed.

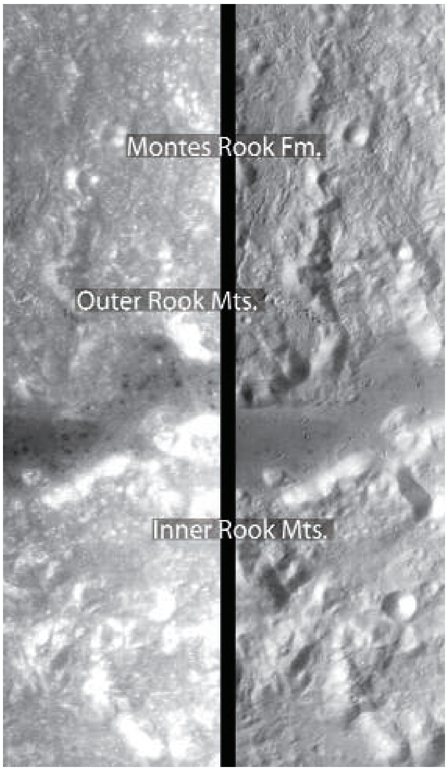
The "lunar magma ocean" hypothesis gained support from later Apollo, ground-based, and orbital observations to become the paradigm for how planetary bodies get their first, or primary, crust. But nearly 40 years after Apollo, no one had directly and unequivocally confirmed the true nature of the lunar highlands.

At the meeting, researchers from two ongoing missions to the moon reported that they now have the final, direct proof. The latest spectroscopy from lunar orbit shows that the key diagnostic rock "is everywhere," said planetary spectroscopist Carlé Pieters of Brown University. Orbiting spectrometers can finally see the lunar surface in fine enough detail and split the spectral colors of the surface into small enough bits to reveal the composition of the highlands unambiguously, speakers said.

Mineralogists expected the whitish mineral plagioclase to crystallize from any lunar magma ocean and float to the top. There it would form a primary crust tens of kilometers thick made of anorthosite, rock consisting of nearly 100% plagioclase. Although cruder spectroscopic searches showed strong hints of anorthosite, a thin surface layer—perhaps impact debris—seemed to be at least partially masking the long-sought primary crust.

Pieters, principal investigator of NASA's Moon Mineralogy Mapper instrument flying onboard India's Chandrayaan-1 spacecraft, reported that "the entire Inner Rook Mountains is anorthosite. That validates the magma ocean." The huge impact that formed the great Mare Orientale basin threw up those mountains to expose the anorthosite. And Makiko Ohtake of the Japan Aerospace Exploration Agency in Sagamihara, Kanagawa, and her colleagues operating the Multiband Imager on JAXA's Kaguya spacecraft reported finding anorthosite exposed in 70 impact craters around the moon. Case closed.

Meanwhile, scientists trying to tell a similar story about another once-magma-covered body—the planet Mercury—continue to draw blanks. "We're not even sure what [its primary crust] would look like," says planetary geologist James Head III of Brown, summing up meeting presentations. The MESSENGER spacecraft has now imaged 90% of Mercury's surface during two flybys, MESSENGER team members including Head reported, and there's no sign of anorthosite but plenty of younger lavas. But Mercury's rock is lower in iron than the moon's is, so entirely different minerals may have floated to form a crust. MESSENGER scientists may be seeing such an alternative primary crust where impacts have punched through the lavas, but they have yet to recognize it. Perhaps after MESSENGER goes into orbit around Mercury in 2011, all will become plain there as well. **–RICHARD A. KERR**



Bright pay dirt. Regions bright at visible wavelengths (*left*, 40-kilometer-wide swath) mark the moon's first crust of nearly pure plagioclase.

Water Everywhere on Mars, But Is Any of It Ever Liquid?

Water on Mars is nothing new. It's been "discovered" many times, but it's always frozen. The liquid form would be so much more exciting in an astrobiological way. At the meeting, meteorologist Nilton Renno of the University of Michigan, Ann Arbor, and 21 of his teammates on the Phoenix mission to Mars reported Phoenix observations buttressed with thermodynamic arguments that suggest to Renno, at least, that briny liquid water exists at the Phoenix site. Not everyone agrees.

Renno starts with the discovery of both ice and salts in the soil of the Phoenix landing site. As he sees it, temperature swings from day to day or millennium to millennium should drive water from the ice into the salts, which become wet and dissolve. Even when it gets much colder, the briny water will stay liquid longer.

Renno points to blobs adhering to a leg of the Phoenix lander as evidence that local salts will keep water liquid even under current Mars conditions. In still images of the leg, he sees the blobs—apparently blown there by the Phoenix landing rockets—growing, moving, and dripping. And where the Phoenix arm dug through icy soil, he sees signs of soft frozen brine rather than hard, clean ice. "Not everyone [on the team] agrees with everything," he says, "but I think they're moving toward agreement."

Not yet. Some team members, such as physicist Michael Hecht of NASA's Jet Propulsion Laboratory in Pasadena, California, who is not a co-author, contest Renno on almost every point. But Renno co-author and chemist Samuel Kounaves of Tufts University in Medford, Massachusetts, says, "Nilton may be right about what we have under Phoenix, but the environment there during landing was extreme and very different. It doesn't mean [liquid water] is possible on Mars. We need some lab experiments, but even then we may never know." **–R.A.K.**

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